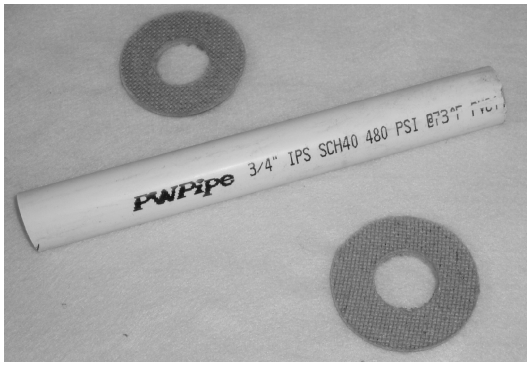
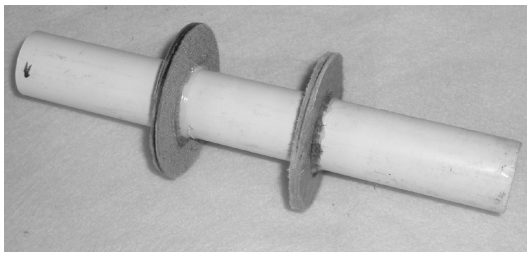
Simple Generator

A moving magnet will create an electric current in a stationary conductor, and a stationary magnet will create an electric current in a conductor that moves by. All that matters is relative motion (this is where Einstein's theory of relativity comes from). This little gem, while a bit tricky to build, is about the best way to show this.





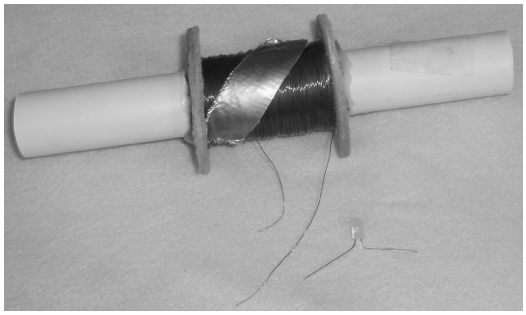
Materials:

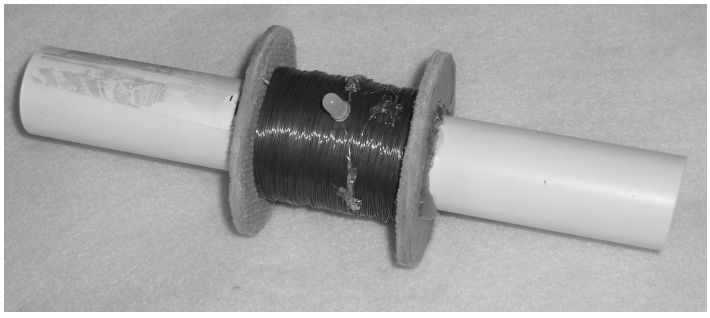
1) A 20 cm (about 8") long piece of 3/4" schedule 40 pvc pipe.
2) Two doughnut shaped pieces of 1/8" thick hardboard (the stuff peg boards are made of, without the holes) cut to an inner diameter of 1 and 1/16 of an inch, and an outer diameter of 2 and ½ inches.
3) 130 grams (about 5 oz) or 200 m (656 ft) of 28 or 30 gauge enamel coated solid copper wire (magnet wire). Radio Shack does not usually carry this much wire in one piece. You will have to order it from an electrical supply place. I order it from Allied Electronics (http://www.alliedelec.com/) in Boise.
4) A two-wire led (light emitting diode). I prefer a bi-colored led, so you can show kids that the current switches direction if a magnet passes all the way through the wire loops. Radio Shack does have these.
5) five or six strong rare-earth ring magnets, 7/8" outer diameter, 3/8" inner diameter. You can also find these at Radio Shack, but Educational Innovations (http://www.teachersource.com/) sells them for a lot less.
6) A 12" long 3/8" hardwood dowel.
7) Scissors, sandpaper, tape, and a hot glue gun.
8) Optional: power drill, a 40 cm (about 16") long 1/4" threaded rod, six 1/4" nuts, four 2" diameter washers with 1/4" holes, two 3/4" diameter corks, and two metal somethings with 5/16" or 3/8" holes clamped or otherwise stuck to something else that can support a spinning 1/4" threaded rod at the ends. Hopefully this will make a bit more sense when you finish reading this!

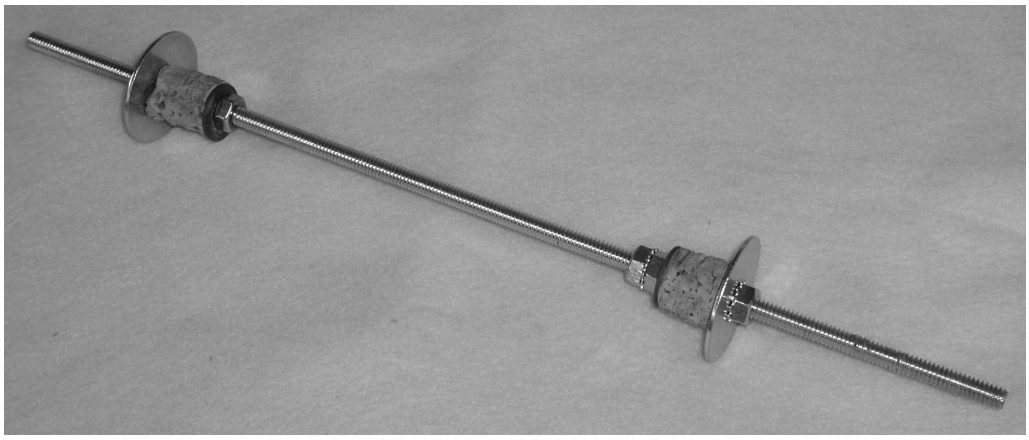
Assembly:

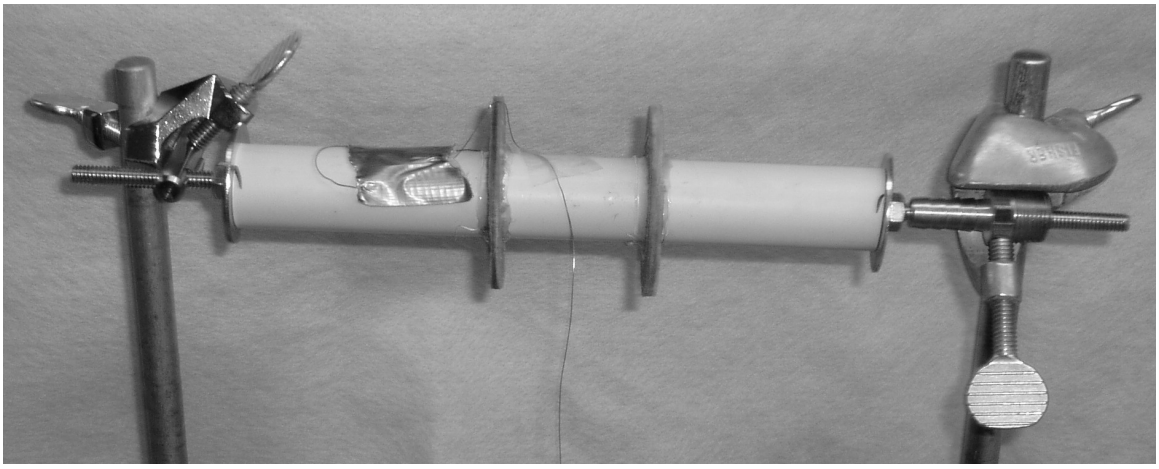
1) Cut the two doughnut shaped pieces out of 1/8" thick hardboard. A jigsaw or keyhole saw will work for cutting the outside, since it does not have to be perfectly round. It does make the winding of the wire easier if all outer corners are rounded. For the inner hole, it must be as close to a 1 and 1/16 of an inch diameter circle as possible. If you have access to a 1 & 1/16" spade bit or hole saw, this is easy. If not, drill a 1" diameter hole, and sand or file it out to 1 & 1/16". It must fit snug over the 3/4" schedule 40 pvc pipe, which has on outer diameter of 1 & 1/16".

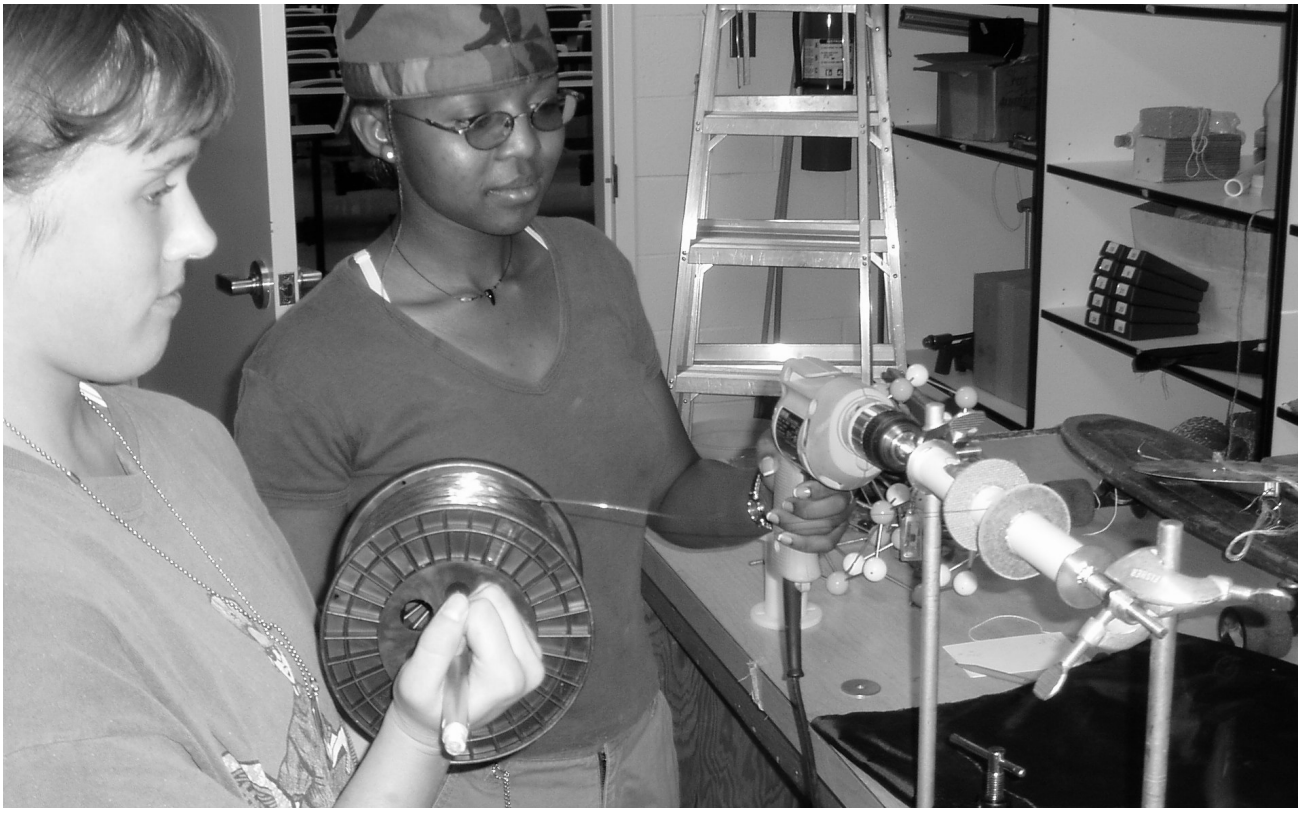
2) Slide the two hardboard doughnuts onto the 3/4" schedule 40 pvc pipe so that they are centered, but 6 cm (about 2 & ½") apart. Glue them in place with hot glue, making sure that they are perpendicular to the pvc pipe. You can check this by spinning the pipe and seeing if the hardboard pieces wobble.
3) Tape the wire, 12 cm (about 5") from one end, to the pvc pipe between the two hardboard pieces right where the one piece meets the pvc. Bend the short end of the wire around the hardboard piece and tape it to the pvc outside of the hardboard pieces. Make sure that the short end of the wire will be out of the way when you wind up the rest of the wire between the hardboard pieces.
4) Now comes the tedious part. Wind all 200 m of the wire, minus the 12 cm, to the pipe between the hardboard pieces. Always wind in the same direction, and try to prevent any kinks or sharp bends in the wire.
5) Scrape the enamel off of the last 2 cm of each wire end with sandpaper. It can be scrapped of with scissor blades too. Bend the wire leads that come out of the led so that the leads can lie along the magnet wire loops. Tightly wrap one magnet wire end to each of the two wire leads on the led. Fix the diode near the middle of the coil of wire with hot glue. The lens of the led (the domed end on the opposite side of where the wire leads come out) must point outward. Also glue down any loose loops of wire so they do not catch on anything.
6) Optional winding method. If you have a power drill and love to tinker, the coil can be wound in about 10 minutes once you set up a support and holder for something fixed to the pipe running through its center that a power drill can clamp to and spin. I used a 40 cm (about 16") long 1/4" threaded rod, six 1/4" nuts, four 2" diameter washers with 1/4" holes, and two 3/4" diameter corks with a 1/4" hole drilled through them. The nuts, washers, and corks all went on the threaded rod like a shish-kebab, so that the pvc pipe is sandwiched between big washers on the ends. As the threaded rod turned, so did the pvc pipe. The corks keep the threaded rod in the center of the pvc pipe. You want to be able to mount the pvc pipe so that it can spin like a rotisserie with a power drill clamped to one end. I used odd pieces of metal with 3/8" holes clamped to steel rods. Short (about 1") lengths of 3/8" copper pipe clamped or duct-taped to vertical boards or a ladder should work too.











7) Thread the magnets onto one end of the hardwood dowel, 2 cm (about 3/4") from the end, and tape them in place to make the “magnet wand”.

Stick the magnet wand inside the simple generator and move the magnets back and forth through the wire coils. The led should blink with the electric current you generate. If you used a bi-colored led, it will blink one color as you move the magnets into the coil, and blink the other color as you move the magnets out of the coil. The current created will go one way if the magnetic field between the coils is getting stronger, and go the other way if the magnetic field between the coils is getting weaker. What you have is a natural AC generator! You will also get current and see the led blink if you hold the magnets still inside the pipe and move the wire coils back and forth over the magnets. Remember, only relative motion, and relative changes in electric and magnetic fields matter. You can also make it blink by taking the magnets off of the dowel, placing them inside the pipe, holding both ends of the pipe closed with your hands, and shaking the magnets back and forth through the coils.